Feb. 10, 1948. M. CAMRAS 2,435,871

RECORDING AND REPRODUCING HEAD FOR WIRE RECORDERS

Filed Aug. 26, 1944

Fig. 1

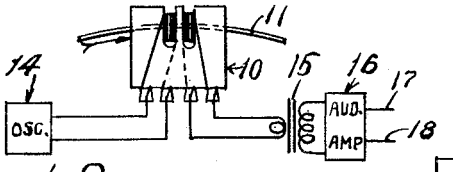


Fig. 5

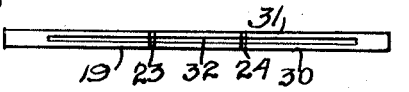


Fig. 2

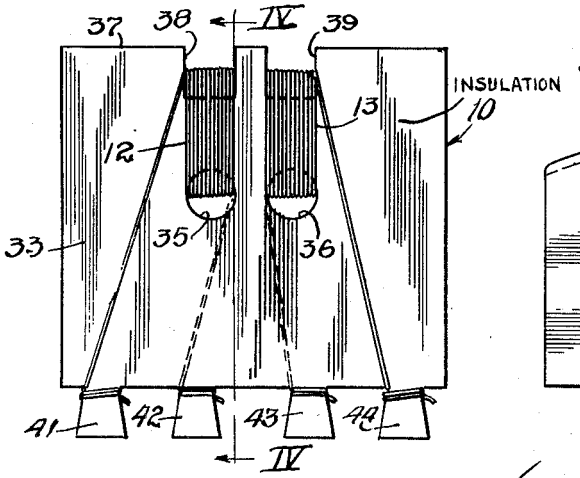


Fig. 6

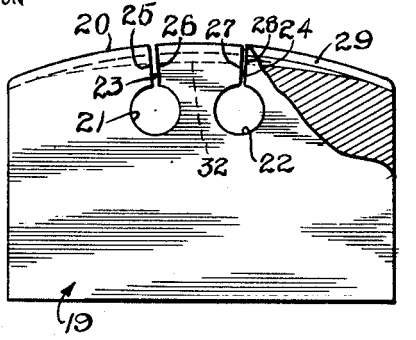


Fig. 3

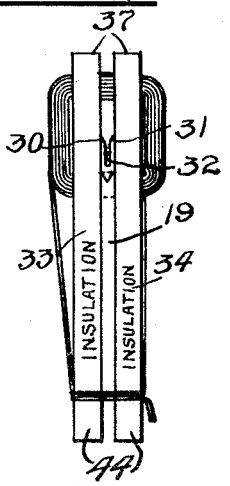


Fig. 4

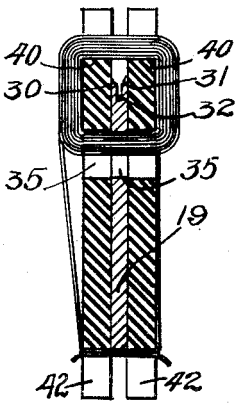
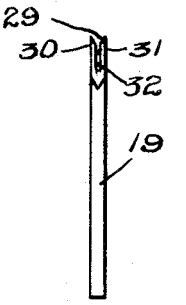


Fig. 7



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RECORDING AND REPRODUCING HEAD FOR WIRE RECORDERS

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10 Claims. (Cl. 179—100.2)

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This invention relates to a recording and reproducing head for magnetic wire recording and reproducing devices, and more particularly to a low impedance head.

In magnetic recording and reproducing devices it has been found desirable when high fidelity is required, to pass the wire upon which the recording is to be made, or upon which a recording has been made, through the exciting coil of the recording and reproducing head. It has further been found desirable to provide some means which will bypass knots or other irregularities in the wire. A still further feature which has been found desirable in magnetic recording and reproducing heads is to provide a head having a relatively low impedance and yet, at the same time, not having such a low impedance that the contact resistance of the switching elements in the circuits will be any substantial portion of the total impedance of the circuit in which the recording and reproducing head is placed.

It is an object of the present invention to provide a novel recording and reproducing head having the above highly desirable characteristics.

It is a further object of the present invention to provide a novel recording and reproducing head which is simple in construction, economical to manufacture and which is efficient in operation.

Another object of the present invention is to provide a novel magnetic recording and reproducing head of relatively low impedance having a substantially flat frequency response over a wide range of frequencies.

A still further object of the present invention is to provide a novel recording head for magnetic recording devices of the type which employs a magnetizing field excited by the joint action of the audio current and a high-frequency current.

Another and still further object of the present invention is to provide a novel structure for a magnetic recording and reproducing head.

Still another and still further object of the present invention is to provide a novel method and means for recording on a wire or other traveling medium.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization, manner of construction, and methods of operation, together with further objects and advantages thereof, may best be understood by reference to the accompanying drawing, in which:

Figure 1 is a diagrammatic illustration of a magnetic recording and reproducing head and its excitation circuit;

Figure 2 is an enlarged front elevational view of a magnetic recording and reproducing head embodying the novel teachings of the present invention;

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Figure 3 is an end view of the magnetic head shown in Figure 2;

Figure 4 is a vertical sectional view taken along the line IV—IV of Figure 2;

Figure 5 is a top view of the magnetizable core or plate members employed in the assembly shown in Figures 2, 3 and 4;

Figure 6 is a front elevational view of the magnetizable plate or core member shown in Figure 5; and

Figure 7 is an end view of the plate shown in Figure 6.

As shown in Figure 1 of the drawings, the magnetic recording and reproducing head 10 is arranged to receive a traveling wire or record medium 11. This traveling wire or record medium 11 passes through two coils 12 and 13 mounted on the magnetic head 10. The coil 12 is electrically connected to a high-frequency oscillator 14 while the coil 13 is electrically connected through a coupling transformer 15 to an audio-amplifier 16. The audio-amplifier 16, in turn, is connected through conductors 17 and 18 to a microphone circuit or to a loud speaker circuit, depending upon whether the magnetic head 10 is being employed as a recording head or as a reproducing head. The audio amplifier 16 may be eliminated if sufficient gain is otherwise obtained. The coupling transformer 15 may be eliminated if the impedance of the circuit to which the head 10 is connected is the same as the impedance of the head.

While the oscillator 14 has been referred to as a high-frequency oscillator, it will be understood that this is a relative term and that the frequency of oscillation thereof is merely high as compared to the frequency of the waves to be recorded or reproduced.

The term "magnetic head" will hereinafter be employed to refer to the magnetic recording and reproducing head irrespective of whether it is being employed to record or reproduce and irrespective of whether or not it includes an erasing means. The term "audio" will hereinafter be employed to designate frequencies which are relatively low compared with the frequencies supplied by the oscillator, but it is to be distinctly understood that this term does not limit the frequencies to the range of frequencies normally audible to the human ear. Indeed, recordings have been made of frequencies much higher than the audible range, such, for example, as 80 kilocycles.

The traveling record medium or wire 11 may be of any suitable magnetizable material having relatively high magnetic retentivity. This traveling record medium may, for example, be formed of a medium or high carbon steel or any of a number of ferromagnetic materials or alloys which may be substantially permanently magnetized.

In Figures 2 to 7 of the drawings I have illustrated one specific physical embodiment of a magnetic head embodying the principles of the present invention. More particularly, the magnetic head 10 includes a magnetizable plate or core member 19 of relatively soft magnetizable material having a low coercive force. This plate 19, after it has been machined in a manner presently to be described, is preferably annealed in hydrogen.

The configuration of this magnetic core member 19 may best be seen in Figures 5, 6 and 7 of the drawing. One edge 20 of the plate 19 is slightly curved to provide a crown. Two relatively large holes 21 and 22 are provided in proximity to the crown 20, and two slits 23 and 24 extend from the holes 21 and 22 to the crowned edge 20. The slit 23, as indicated, is somewhat larger than the slit 24. The arrangement of the holes 21 and 22 and the slits 23 and 24 provide two pairs of confronting polar portions 25—26 and 27—28.

The crowned edge 20 is provided with a flaring groove 29 therealong provided by the diverging wall portions 30 and 31 (see Figure 7). The bottom of the groove 29 is further provided with a groove or recess 32 having a greater radius of curvature in the transverse plane of the plate 19 than does the flaring groove 29 or the crowned edge 20. This inner groove 32 has vertically disposed side walls (as may be seen in Figure 7) and is arranged to receive the traveling record medium 11. The diameter of the wire or traveling record medium 11 is substantially the same as the spacing between the opposed side walls of the groove 32 so as to just fit therebetween and yet provide a freely sliding fit. Due to the difference in the radius of curvature of the inner groove 32 as compared with the outer flaring groove 29, it will readily be apparent that if a knot or other enlargement on the wire or traveling record medium 11 strikes the plate 19, it will ride up out of the inner groove 32 and pass through the magnetic head along the outer flaring groove 29 which will conveniently provide for the passage of such a knot.

Referring now to Figures 2 to 4 of the drawing, it will be seen that the plate or core member 19 is retained between two plates 33 and 34 of insulating material, such for example, as Bakelite. Each of the two plates 33 and 34 is provided with holes 35 and 36 of a slightly smaller diameter than the holes 21 and 22 of the core member 19. The centers of the holes 35 in the plate members 33 and 34 are arranged to be aligned with the center of the hole 21 in the core member 19. The centers of the holes 36 in the plate members 33 and 34 are arranged to be aligned with the center of the hole 22 of the core member 19. The plates 33 and 34 are preferably of substantially the same width as the core member 19, but are substantially higher. The upper edge 37 of each plate member 33 and 34 is notched out as at 38 and 39. As may be seen best in Figure 4, the bottoms 40 of the notches 38 and 39 are higher than the topmost point on the crown surface 20 of the core member 19.

The lower edges of the plate members 33 and 34 are provided with four tabs 41, 42, 43 and 44. These tabs 41 to 44 are for the purpose of providing convenient means for securing the ends of the coils 12 and 13.

To assemble the magnetic head, the gap between the confronting polar portion 25—26 and

the gap between the confronting polar portion 27—28 of the core member 19 are preferably filled with solder and filed smooth. This is for the purpose of keeping dust and other foreign material out of the gaps, it being remembered that solder is a non-magnetic material. The core member 19 is then glued or cemented to one of the insulating plates, such for example as the insulating plate 33, with the holes 21 and 22 centered on the holes 35 and 36 respectively. The other insulating plate 34 is then glued or cemented to the other side of the core member 19 with its holes 35 and 36 also aligned with the holes 21 and 22. The coils 12 and 13 are then wound on the assembly by threading the wire through the holes 35 and 36 respectively and through the notches 38 and 39. It has been found that a convenient coil structure may be provided with approximately twenty turns of No. 28 wire. It has been found that a convenient size for the magnetic head may be obtained by using a core member ¾ inch in width, ½ inch in height to the top of the crown, and .020 inch in thickness. It has been further found, by way of example, that a convenient width of the slot 23 may be had by employing a slot which is approximately .010 inch. It has further been found, by way of example, that one satisfactory width for the slot 24 is .002 inch. This particular illustrated embodiment is designed particularly for use with a traveling wire of .004 inch in diameter and having a wire speed in the neighborhood of 5 feet per second.

With a construction of the type described above, it has been found unnecessary to directly feed high-frequency current into the electric circuit of the coil 13 for recording, due to the fact that the high-frequency current supplied to the erasing coil 12 will establish a magnetic field in the core member 19 which extends over and is superimposed on the magnetic field established by the audio current fed to the coil 13 from the coupling transformer 15. Thus the wire 11 traveling in the direction as indicated by the arrow in Figure 1, is first demagnetized by passing through the highly concentrated field set up by the coil 12 between the polar portions 25 and 26 and then passes through a magnetic field which is the resultant of the audio-frequency exciting current in the coil 13 and the stray magnetic field in the vicinity of the polar portions 27 and 28 which results from the high-frequency exciting current in the coil 12. It has been found that extremely high fidelity of recording and reproduction may be obtained on employing a head of this character.

It has further been found that the crowned edge portion of the core member 19 with its flared outer groove of one radius of curvature and its deep cut inner groove of a greater radius of curvature provides an extremely simple means for bypassing a knot in the wire 11.

It will further be apparent that the above magnetic head is extremely economical to manufacture and its simple method of assembly eliminates the need for highly skilled labor to form the head.

Reference has been made above to the fact that the air gaps formed by the slits 23 and 24 may be filled with solder, if desired, to keep out foreign particles and material. A groove may be especially formed in the solder to correspond to the grooves 29 and 32, if desired. It has been found, however, in practice, that this is not a necessary forming operation, since this soft solder immediately wears down upon the initial passage of a wire through the groove in the core member 19.

While I have shown a particular embodiment of my invention, it will, of course, be understood that I do not wish to be limited thereto, since many modifications may be made, and I, therefore, contemplate by the appended claims, to cover all such modifications as fall within the true spirit and scope of my invention.

I claim as my invention:

1. A magnetic head comprising a paramagnetic plate, said plate having a pair of holes therein and having a slot extending between each of said holes and one of the edges of said plate, a coil extending through one of said holes and over the slot associated therewith, a second coil extending through the other of said holes and over the slot associated therewith, one of said coils being arranged to be connected to a source of high-frequency alternating current and the other of said coils being arranged to be connected to a source of relatively low-frequency alternating current, said one edge of said plate having a groove extending therealong and arranged to have a wire of high magnetic retentivity travel therein.

2. A magnetic head comprising a paramagnetic plate having a hole therein and a slot extending from said hole to one edge of said plate, a pair of plates of insulating material secured on opposite sides of said paramagnetic plate, each of said insulating plates having a hole therein centered on the hole in said paramagnetic plate, a coil wound through said aligned holes and above said one edge of said paramagnetic plate in proximity to said slot, said one edge of said plate being arranged to have a traveling ferromagnetic record medium pass lengthwise therealong.

3. A magnetic head comprising a paramagnetic plate having a hole therein and a slot extending from said hole to one edge of said plate, a pair of plates of insulating material secured on opposite sides of said paramagnetic plate, each of said insulating plates having a hole therein centered on the hole in said paramagnetic plate, the holes in said insulating plates being slightly smaller in diameter than the hole in said paramagnetic plate, a coil wound through said axially aligned holes and above said one edge of said paramagnetic plate in proximity to said slot, said one edge of said plate being arranged to have a traveling ferromagnetic record medium pass lengthwise therealong, said coil being arranged to be coupled to an electronic amplifier.

4. A magnetic head comprising a paramagnetic plate having a hole therein and a slot extending from said hole to one edge of said plate, a pair of plates of insulating material secured on opposite sides of said paramagnetic plate, each of said insulating plates having a hole therein centered on the hole in said paramagnetic plate, the holes in said insulating plates being slightly smaller than the hole in said paramagnetic plate, said insulating plates being dimensioned to overlap said paramagnetic plate in the vicinity of said slot, a coil wound through said aligned holes and over said overlapped portions of said insulating plates above said slot, said one edge of said paramagnetic plate being arranged to have a traveling ferromagnetic record medium pass lengthwise therealong and through said coil, said coil being arranged to be coupled to an electronic amplifier.

5. A magnetic head comprising a paramagnetic plate, said plate having a pair of holes therein and having a slot extending between each of said holes and one of the edges of said plate, one of said slots being wider than the other, a coil extending through one of said holes and over the slot associated therewith, a second coil extending through the other of said holes and over the slot associated therewith, said coil associated with said wider slot being arranged to be connected to a source of high-frequency alternating current and said other coil being arranged to be connected to a source of relatively low-frequency alternating current.

6. A magnetic head comprising a paramagnetic plate having a pair of holes therein and a slot extending from each of said holes to one edge of said plate, a pair of plates of insulating material secured on opposite sides of said paramagnetic plate, each of said insulating plates having a pair of holes therein centered on the hole in said paramagnetic plate, a pair of electric coils, one of said coils extending through one of said aligned group of holes and above said one edge of said paramagnetic plate in proximity to the slot associated therewith, the other of said coils extending through the other aligned group of holes and above said one edge of said paramagnetic plate in proximity to the slot associated with that group of holes, said one edge of said paramagnetic plate being arranged to have a traveling ferromagnetic record medium pass lengthwise therealong and through said coils, one of said coils being arranged to be coupled to an electronic amplifier and the other of said coils being arranged to be coupled to a source of relatively high-frequency oscillation.

7. A core member for a magnetic head comprising a paramagnetic plate having one edge thereof curved in the plane of the plate, a flaring groove in said edge extending lengthwise therealong and having substantially the same radius of curvature as said curved edge, a relatively narrow groove arranged in the bottom of said flaring groove and arranged to receive a traveling record medium, the bottom of said narrow groove being curved in the plane of said plate and having a greater radius of curvature than said flaring groove, whereby said narrow groove gradually becomes shallower from the center of said curved edge toward either end thereof and gradually merges into said flaring groove, and whereby means is thus provided for shifting a traveling record medium temporarily out of said narrow groove when an enlargement in the record medium strikes said plate.

8. A magnetic head comprising a paramagnetic plate having one edge thereof curved in the plane of the plate, a flaring groove in said edge extending lengthwise therealong, a relatively narrow groove, the bottom of said flaring groove arranged to receive a traveling ferromagnetic wire, the bottom of said narrow groove being curved in the plane of said plate and having a greater radius of curvature than said curved edge, whereby said narrow groove gradually becomes shallower from the center of said curved edge toward either end thereof and gradually merges into said flaring groove, and whereby means is thus provided for shifting a traveling wire temporarily out of said narrow groove when a knot or other enlargement in the wire strikes said plate, said plate having a hole therein in proximity to said curved edge and having a slit in said plate extending from said hole to said curved edge, a coil of wire extending through said hole and above said curved edge in proximity to said slit, said coil being arranged to be coupled to an electronic amplifier.

9. A magnetic recorder comprising a coil, means for electrically exciting said coil by the wave to

be recorded, a paramagnetic core member upon which said coil is mounted having a pair of confronting polar portions defining a gap in the paramagnetic material in which a highly concentrated fluctuating magnetic field is established by said coil, said recorder being arranged to have a traveling ferromagnetic record medium pass through said gap, an erasing coil mounted on said core member through which said record medium passes before reaching said first coil, said erasing coil being excited by a relatively high-frequency alternating current which establishes a high-frequency magnetic field, said high-frequency magnetic field serving the dual functions of demagnetizing the traveling record medium before it reaches said first coil and also providing a field which jointly acts with the field established by said wave to be recorded to magnetize the wire.

10. A magnetic head comprising a paramagnetic plate, said plate having a pair of holes therein and having a slot extending between each of said holes and one of the edges of said plate, a coil extending through one of said holes and over the slot associated therewith, a second coil extending through the other of said holes and

over the slot associated therewith, one of said coils being arranged to be connected to a source of high-frequency alternating current and the other of said coils being arranged to be connected to a source of relatively low-frequency alternating current, said one edge of said plate defining a path along which a wire of high magnetic retentivity is arranged to travel.

MARVIN CAMRAS.

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